Oligocene, and it seems unlikely that a "primitive penicillid" should have survived since that separation undetected in the geologic record. It seems even less likely that a modern and true penicillid should revert to the habits and grotesque form of Humphreyia.

Geographic and Geologic Distribution

Clavagella, s. s., is apparently the most primitive group, with questionable records from strata older than the Turonian of Cretaceous in Europe and Africa. The suggestion is consistent with the shell and tube morphology, as Clavagella, s. s., has the appearance least altered from that of a normal burrowing pelecypod. The siphonal portion of the tube is smaller in diameter than the shell, and the adult valves still dominate the anterior portion.

Two distinct groups of clavagellids are reported from strata of Late Cretaceous (Turonian) age in Europe, North America, and in India. The existence of two distinct lines at that time suggests earlier beginnings for the group, perhaps during Early Cretaceous. The Late Cretaceous Clavagella, s. s., and Stirpulina are both found in Europe and before the end of Cretaceous Clavagella, s. s., appeared in Asia and Stirpulina in North America. The exact synchroneity of these occurrences is not known. The two groups may have developed independently in the Pacific and Atlantic areas, but it seems more likely that they branched from a single stock in the European area.

Stirpulina, which did not live beyond Cretaceous in North America, survived with Clavagella, s. s., until Late Pliocene in Europe. Clavagella, s. s., may have a small surviving representative in the moderately deep waters off Australia {C. (C.) multangularis Tate}, and Stirpulina is represented in the Recent faunas by C. (S.) ramosa Dunker in Japanese waters.

The earliest records of Bryopa are from strata of Late Oligocene (Aquitanian) age in France. There are several survivors in the Mediterranean and a few in Indo-Pacific and Australasian provinces.

Dacosta and Humphreyia are known only from living forms in Australia, and neither group is well established.

Penicillus, s. s., is recorded from Late Oligocene strata of N. W. Borneo, Miocene of N. Borneo, Pliocene over the Indo-Pacific area, and Pleistocene of the Indo-Malay and Philippine regions. Though rare, it is reported from a large part of the Western Pacific and Indo-Pacific areas today.

Pseudobrechites is the only penicillid group reported from European strata, and only a single species has been recorded. The specimens were collected from Late Oligocene strata of France, and no other penicillids have been reported from nearer to Europe than the present Red Sea.

Foegia is an entirely Pacific-Indo-Pacific form. Earliest records are from Miocene and Pliocene strata of Sumatra, Formosa, and Japan. It is presently living in the Indo-Pacific and Australasian areas.

Warnea is reportedly living in the Red Sea and in Australasian and Japanese waters. The earliest records are from Pliocene strata of Japan.

The Clavagellacea is at present primarily an Indo-Pacific-Australasian group. Original development in the European area is suggested, and the group has apparently since declined and moved eastward. All of the penicillids have geologic records from at least Pliocene, and only Dacosta and Humphreyia are Recent developments, probably of the clavagellid line.

Generic, Subgeneric, and Specific Taxa

Clavagella LAMARCK, 1818
[*C. echinata;* SD CHILDREN, 1823]

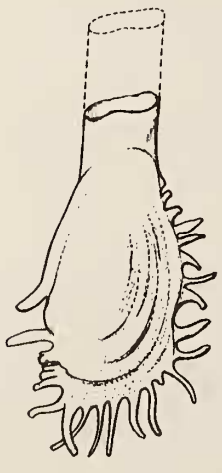
[=Bacilia Gray, 1858, ex Valenciennes MS (obj.) Clavigella, spelling error] One valve never merging with the tube, and both adductors persistent in the adult. U. Cret. (Turonian)-Rec.

C. (?) cenomaniana Orbigny, 1844, p. 157 [nom. nud.] Cret., Fr.
C. (?) dubia Muenster, 1835, p. 435 [nom. nud.]
C. (?) ligeriensis Orbigny, 1844, p. 233 [nom. nud.] Cret., Fr.
C. (?) altavillae Aradas & Calcara, 1843, p. 221; (not seen)
C. (?) dalpiazi Venzo, 1941; (not seen) Olig., Italy
C. (?) lodoiska Caillat, 1835, p. 237 (not seen)
C. (?) lybica Parona, 1923, p. 51; (not seen) U. Cret., Afr.
C. (?) prisca Goldfuss, 1840, p. 285;(not seen)
C. (?) zebuensis Broderip; (not seen) Rec. Philippines

Clavagella (*Clavagella*)

Siphonal end of tube simple; tube free, elongate, clavate, compressed and symmetrical in shape; with irregular spine-like tubules on the anterior portion of the tube. U. Cret. (Turonian)-Rec., Eu.-India-Australas. —Fig. 1. C. (C.) echinata, M.-U. Eoc. (Lut.-Bart.), Paris Basin.

C. (C.) brocchii Lamarck, 1818, p. 432, U. Plioc., Italy
C. (C.) brongniarti Deshayes, 1824, p. 11, U. Eoc., Fr.
C. (C.) cretacea Orbigny, 1845, p. 300, Cret., Fr.
C. (C.) cristata Lamarck, 1818, p. 432, M. Eoc., Fr.
C. (C.) echinata Lamarck, 1818, p. 432, M.-U. Eoc., Fr.
C. (?C.) exiqua Zittel, 1865, p. 107, U. Cret., Austria
C. (C.) lagenula Deshayes (not seen) U. Eoc., Fr.
C. (?C.) lamarcki Deshayes (not seen) M. Eoc., Fr.
C. (C.) multangularis Tate, 1886, Rec., Austral.
C. (?C.) primigenia Deshayes (not seen) M. Paleoc., Fr.
C. (C.) semisulcata Forbes, 1846, p. 139, U. Cret., India
C. (?C.) tibialis (Lamarck, 1818), p. 432 [Fistulana] Eoc., Fr.



(x 0.58)

Figure 1
Clavagella (*Clavagella*)

Clavagella (*Stirpulina*) Stoliczka, 1870
[**C. coronata* Deshayes, 1824]

[=Styrpulina, spelling error. May prove to be synonym of Tubolana Bivona-Bernardi, 1832 (type-species: T. digitata=Aspergillum bacillaris Deshayes, 1830; Tubulana, spelling error)] Siphonal end of tube periodically expanded, anterior end with tubules formed only in terminal corona; tube long with a more or less distinct anterior slit. U. Cret. (Turonian)-Rec., N. Am.-Eu.-Afr.-Asia —Fig. 2. C. (S.) coronata, U. Eoc. (Bart.), Paris Basin.

C. (S.) armata Morton, 1833, p. 129, U. Cret., N. Jersey
C. (S.) aspergillum Bronn, 1828, p. 5 [=C. (S.) bacillum (Brocchi, 1814)]
C. (S.) bacillum (Brocchi, 1814), p. 273 [Teredo], Mioc., Austria
C. (S.) bacillum bacillaris (Deshayes, 1830), p. 239, Plioc., Fr.
C. (?S.) clavata (Roemer) Orbigny, 1850, p. 233, ?Cret., Germany
C. (S.) caillati Deshayes (?MS) M. Eoc., Fr.
C. (?S.) cornigera Schafhaeutl, 1863, p. 179, U. Cret., Bavaria [both valves may be free = ?pre-Clavagella]
C. (S.) coronata Deshayes, 1824, p. 8, U. Eoc., Fr.
C. (S.) digitata (Bivona-Bernardi, 1832), p. 56, ?Plioc., Italy [=C. (S.) bacillum bacillaris (Deshayes, 1830)]
C. (?S.) elegans Müller (not seen) U. Cret., Germany
C. (S.) goldfussi Philippi, 1846, p. 44, L. Olig., Germany
C. (S.) maniculata (Philippi, 1836), p. 1, ?Plioc., ?Italy [? = C. (S.) bacillum bacillaris (Deshayes, 1830)]
C. (S.) oblita Michelotti, 1861, p. 53, U. Olig. (Tongrian), Hungary-Egypt
C. (S.) ramosa Dunker, 1882, p. 172, Rec., Japan

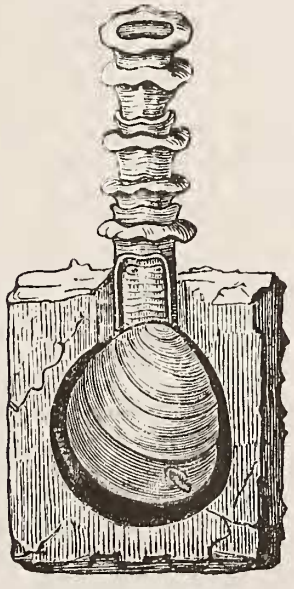
(x 0.4)

Figure 2
Clavagella (*Stirpulina*)

Clavagella (*Bryopa*) GRAY, 1847
[**C. aperta* SOWERBY, 1823]

[= Tiria GREGORIO, 1886 (C. aperta Sowerby; herein desig., Smith, 1962, obj.)] Siphonal end of tube periodically expanded, anterior end smooth; with small short tubules through the tube around the valves. U. Olig. (Aquitanian)-Rec., Medit.-Indo-Pac. — Fig. 3, C. (B.) aperta, Rec., Malta.

C. (? B.) angulata Philippi, 1844, p. 2, Rec., Sicily [?= C. (B.) melitensis Broderip, 1835]
C. (B.) aperta Sowerby, 1823, XIII, Figs. 1-4, Rec., Medit.
C. (? B.) astraeicola Jouss. (not seen)
C. (B.) balanorum Scacchi, 1844, p. 4, Rec., Medit. [? = C. (B.) aperta Sowerby, 1823]
C. (B.) brochoni Benoist, 1877, p. 313, U. Olig., Fr.
C. (B.) laqueata Sowerby (in Reeve), 1873, Rec., ? Medit.
C. (B.) lata Deshayes, 1839, p. 25, Rec., Ind. O.-Austral.
C. (B.) melitensis Broderip, 1835, p. 116, Rec., Medit.
C. (B.) philippiana Sowerby (in Reeve), 1873 [ex Desh. MS] Rec., Medit.
C. (? B.) senilis Jouss. (not seen)
C. (B.) sicula Chiaje, 1830, pl. 83, Rec., Medit. [? = C. (B.) aperta Sowerby, 1823]
C. (? B.) socialis Jouss. (not seen)



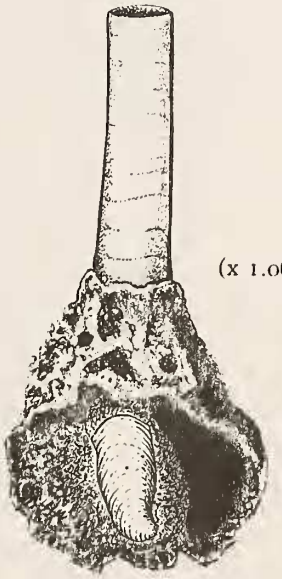
(x 0.8)

Figure 3
Clavagella (*Bryopa*)

Clavagella (*Dacosta*) GRAY, 1858 (*? recte Dacostaia*)
[**C. australis* SOWERBY, 1829, *ex* STUTCHBURY MS]

Siphonal end of tube not expanded, anterior end smooth, rounded; with small, very short tubules through the tube around the valves. Rec., W. Pac. — Fig. 4, C. (D.) australis, Rec., Austral.

C. (D.) australis Sowerby, 1829, app. p. 3, Rec., Austral.



(x 1.06)

Figure 4
Clavagella (*Dacosta*)

Humphreyia GRAY, 1858
[** Aspergillum strangei* A. ADAMS, 1854]

[=Humphreysia, spelling error] Tube twisted and irregularly square in cross-section, both valves united into a single plate forming most of anterior bag-like cavity. Rec., W. Pac. —Fig. 5. H. strangei (A. ADAMS), Rec., Austral.

H. coxi Brazier, 1872, p. 23, Rec. Austral.
H. strangei (A. Adams, 1852), p. 91, Rec., Austral.

(x 1.2)

Figure 5
Humphreyia

Penicillus Bruguière, 1789
[* *P. javanus* = * *Serpula penis* Linnaeus 1758; SD Habe, 1952]

[=Brechites GUETTARD, 1770 (non-binom.); Penecilli DACOSTA, 1776 (vernacular); Penecillus, Penicellus, spelling errors; Verpa ROEDING, 1798 (obj.); Aquaria PERRY, 1811 (A. radiata, herein desig., Smith, 1962, obj.); Bunodus BLAINVILLE, 1817 (nom. nud.) ex GUETTARD (non-binom.); Arytene OKEN, 1815 (obj.; rejected ICZN, 1956); Arytaena OKEN, 1817 (obj.; Arythaena, Arytene, spelling errors); Aspergillum LAMARCK, 1818 (obj.; Adspergillum, Aspergillium, Aspergillus, spelling errors); Clepsydra SCHUMACHER, 1817 (obj.; Clepydra, spelling error)] Both valves merging with tube; tube circular in cross-section; anterior adductor degenerate, posterior adductor absent in adult. U. Olig. (Aquitanian)-Rec.

"Aspergillum cretaceum" Rominger, 1847, p. 659 [nom. nud.] [?= Clavagella (Stirpulina) cornigera Shafhaeutl, 1863]
Aspergillum javanum of Authors=P. (P.) penis (Linnaeus)
Aspergillum sparsus Sowerby =P. (P.) penis (Linnaeus)
Penicillus annulatus Lamarck, 1816 [?= Polychaete Ann.]
Penicillus capitatus Lamarck, 1816 [?= Polychaete Ann.]
Penicillus kobeltianus (Löbbeck, 1879), p. 95 [nom. nud.]
P. (?) listeri (Gray, 1825), p. 135 (not seen)
Penicillus phoenix Lamarck, 1816 [?= Polychaete Ann.]

Penicillus (*Penicillus*)

Siphonal end of tube simple; anterior end fringed with single row of distinct simple tubules; anterior disc with a slit. U. Olig. (Aquitanian)-Rec., Indo-Pac.-Austral.—Fig. 6,
P. (P.) penis (LINNAEUS), Rec., Singapore
P. (P.) annulatus (Thiele, 1934), p. 943, ex Deshayes ?MS
P. (P.) annulus (Gray, 1858), p. 312, ex Deshayes MS, Pleist., Indo-Malay-Philippines
P. (P.) clavatus (Chenu, 1843), p. 4, Hab.-?
P. (P.) coronatus (Sieverts, 1934), p. 267 Plioc., Indo-Pac.
P. (P.) dichotomus (Chenu, 1843), p. 3, Plioc., Java
P. (P.) disjunctus Sowerby in Reeve, 1860, sp. 12, ex Deshayes MS, U. Plioc., Indo-Malay
P. (P.) incrassatus (Chenu, 1843), p. 4, ?Rec., Austral.
P. (P.) ornatus (Chenu, 1843), p. 4 [=P. (P.) tuberculatus (Chenu, 1843)]
P. (P.) penis (Linnaeus, 1758), p. 788, Rec., Ind. O.
P. (P.) pulcher Sowerby in Reeve, 1860, ex Deshayes MS, Rec., Singapore
P. (P.) pulcher fossilis (Sieverts, 1934), p. 269, Mioc., N. Borneo
P. (P.) radiatus (Perry, 1811), pl. 52, Hab.-? [=P. (P.) penis (Linnaeus, 1758)]
P. (P.) radix Gray (not seen) ex Deshayes MS, U. Plioc., Indo-Malay
P. (P.) recluzianus (Chenu, 1843), p. 4 [=P. (P.) incrassatus (Chenu, 1843)]
P. (P.) semifimbriatus (Chenu, 1843), p. 4, Rec., ?Red Sea
P. (P.) strangulatus (Chenu, 1843), p. 3, Rec., Austral.
P. (P.) tuberculatus (Chenu, 1843), p. 3, Rec., Moluccas
P. (?P.) venustulus (Beets, 1942), p. 230, Mioc., N. W. Borneo

Figure 6
Penicillus (Penicillus)

Penicillus (*Pseudobrechites*) MAGNE, 1941
[* *Aspergillum leognanum* HOENINGHAUS, 1827]

Similar to P. (Penicillus), but fringe tubules shorter, less distinct, and anterior disc without central slit. U. Olig. (Aquitanian), Eu. —Fig. 7. P. (P.) leognanus (HEONINGHAUS, 1827), p. 4, U. Olig., Fr.

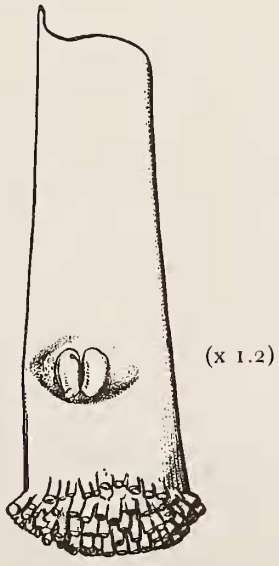


Figure 7
Penicillus (Pseudobrechites)

Penicillus (*Foegia*) GRAY, 1847
["*Aspergillum novaezelandiae*" (= * *P. novaezelandiae* BRUGUIÈRE, 1789)]

Umbo almost covered with swollen prominence; fringe indistinct, formed like slit in disc, of short thick tubules. U. Olig. (Aquitanian)-Rec., Indo-Pac.-W. Pac. —Fig. 8. P. (F.) novaezelandiae BRUGUIÈRE, Rec., Australas.

P. (F.) agglutinans Lamarck, 1818), p. 430, Rec., Indo-Pac.
P. (F.) cumingianus (Chenu, 1843), p. 3, Rec., Austral.
P. (F.) giganteus (Sowerby, 1888), p. 290, Mioc.-Plioc., Sumatra, Formosa, Japan; Rec., Japan
P. (?F.) imbricatus (Perry, 1811), pl. 52, Hab.-?
P. (F.) novaehollandiae (Chenu, 1843), p. 4, Rec., New Holland [=P. (F.) agglutinans (Lamarck, 1818)]
P. (F.) novaezelandiae Bruguière, 1789, p. 129, Rec., Austral.
P. (F.) novaezelandiae incertus (Chenu, 1843), p. 4, Rec., Austral.
P. (F.) philippiensis (Chenu, 1843), p. 3, Rec., Philippines
P. (F.) zebuensis (Chenu, 1843), p. 3, Rec., Philippines [=P. (F.) agglutinans (Lamarck, 1818)]

Figure 8
Penicillus (Foegia)

Penicillus (*Warnea*) GRAY, 1858

[* *Aspergillum australe* CHENU, 1843; SD STOLICZKA, 1871]

Tube cylindrical, siphonal end with series of plaited ruffles; fringe distinct, of a single series of thick simple tubules. Plioc.-Rec., Red Sea-Australas.-Japan — Fig. 9, P. (W.) australis (Chenu), Rec., Australas.

P. (W.) australis (Chenu, 1843), p. 3, Rec., Australas.

P. (W.) delessertianus (Chenu, 1843), p. 3, Rec., Red Sea

P. (W.) vaginiferus (Lamarck, 1818), p. 430, Rec., Red Sea

P. (W.) yokoyamai (Shikama, 1955), Plioc.-Rec., Japan

(x 0.8)

Figure 9
Penicillus (*Warnea*)

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A New Dampierian *Cypraea*

BY

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(Plate 40; 1 Textfigure)

During the summer of 1960, Mr. A. R. Whitworth of Carnarvon, Western Australia, sent me three specimens of an unknown Cypraea from Vlaming Head, Northwest Cape, Western Australia, asking if they might belong to the subspecies Cypraea cernica tomlini Schilder, 1930. Mr. Bernard C. Cotton of the South Australian Museum had identified one of these shells as C. cernica Sowerby, 1870, referring to the illustrations of that species in Cotton and Steadman (1946, p. 522) and Allan (1956, p. 94). (Personal communication to Mrs. T. Hartley, May 1960.)

To me, the shells were readily enough recognizable as related to Cypraea cernica, though they seemed to differ in a general way from that species and from typical C. c. tomlini; moreover, the type locality of C. c. tomlini (Lifu, New Caledonia) is far enough removed from Western Australia to give me further reason for hesitating to put either name on the unknown shells. Consequently, I asked Mr. Whitworth for additional shells to study; he sent me the remaining six in his collection. None of the shells were live-taken (all having been picked up on the beach after storms), but most are in reasonably good to excellent condition.

Cypraea cernica at present comprises four geographical races. Schilder (1938: p. 223, Map 1) has defined certain geographical provinces and regions which have rather definite limits. The "races" are groups of individuals of one species separated by zones of nonoccurrence. Cypraea cernica's four races (C. c. cernica, C. c. tomlini, C. c. ogasawarensis, and C. c. marielae) are located in the following Schilderian geographical regions: Lemurian, Melanesian, Japanese, and Hawaiian, respectively.

Since the Western Australian form shows certain morphological and color differences from Cypraea cernica s. s., and since its typical locality is in a completely different geographical area (the Dampierian Region) separated by zones to the north and south in which no forms of C. cernica are presently known to exist, it is my opinion that the Western Australian specimens belong to a new subspecies.

Cypraea (Erosaria) cernica viridicolor CATE, subspec. nov.

Shell solid, humped, pyriformly ovate, narrowing abapically; base and sides rounded, right and left margins excurvate, callous; inductura distinctly and evenly pitted above marginal edge; aperture fairly straight, narrow, curving sharply left adapically; both terminals produced, abapical terminal more so. Teeth fine, well defined, centrally short on columella, lengthening obliquely on the labial area adapically; outer labial teeth heavier, longer, covering most of outer lip except at central marginal edge; terminal ridge extending across fossula; first four or five teeth extending across and terminating prominently on adaxial edge of fossula. Dorsal inductura smooth, glossy, light olive-green, very generously covered with irregularly sized small white spots; white mantle line traverses length of upper right dorsum; base, teeth, interstices white; numerous large and small chestnut spots on upper marginal surface, ocellating some white spots, and continuing over terminal collars.

In Cypraea cernica viridicolor the shell is more flattened and less humped than in C. c. cernica, though approaching it more nearly than in the other subspecies; the base from the left margin to the columella is narrower and straighter; the teeth are finer, shorter, and less elevated, particularly on the outer lip; on the fossula they are less numerous and weaker. Cypraea c. viridicolor differs in being larger, broader in relation to its length, flatter and more solid in general. Its color is a lighter greenish-beige, with the lateral spots much larger, more numerous, and more distinct.

The name viridicolor stems from the Latin viridis, meaning green, and color, meaning hued, in reference to the peculiar greenish hue.

The type locality of Cypraea cernica viridicolor is Vlaming Head, Northwest Cape, Western Australia (21° 50' S. Lat., 114° 10' E. Long.). Knowledge of its range is limited at this time, with only two known collecting stations, Vlaming Head and Quobba Point, approximately 40 miles

north of Carnarvon.

The holotype will be deposited in the Paleontological Type Collection at Stanford University, Stanford, California (No. 9'506). Paratypes and hypotype are in the respective collections of C. N. Cate and A. R. Whitworth.

Addition of the new subspecies brings the recognized number of geographical races of Cypraea cernica to five, two others being of doubtful standing (C. c. percomis Iredale, 1931, and C. c. prodiga Iredale, 1939). Starting in the westernmost region with the typical species and working in a more or less counter-clockwise direction, these races may be enumerated as follows (see map, textfigure 1):

Subspecies	Region	Type Locality
Cypraea cernica cernica SOWERBY, 1870	Lemurian	Mauritius
Cypraea cernica viridicolor subspec. nov.	Dampierian	Vlaming Head, NW Cape
Cypraea cernica tomlini SCHILDER, 1930	Melanesian	Lifu, New Caledonia
Cypraea cernica marielae CATE, 1960	Hawaiian	Maui, Hawaii
Cypraea cernica ogasawarensis SCHILDER, 1945	Japanese	Bonin Islands

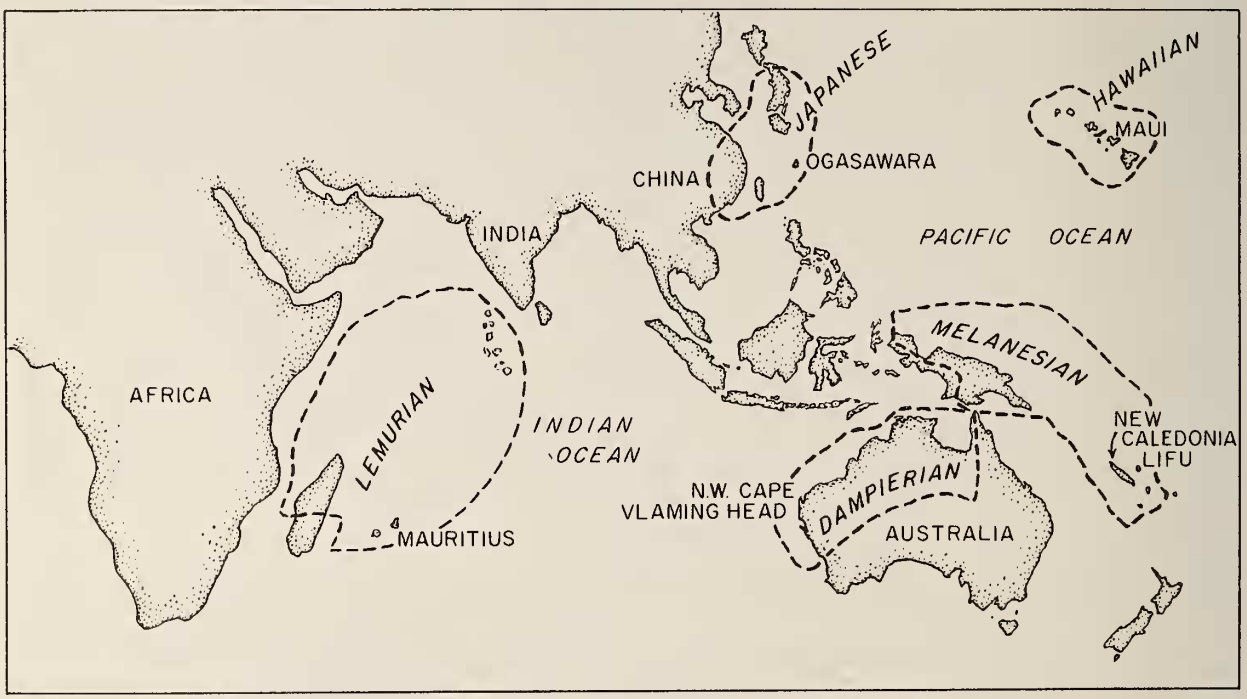

Figure 1: Map showing the boundaries of five geographical regions according to SCHILDER (1938)

Explanation of Plate 40

Cypraea cernica viridicolor C. CATE, subspec. nov.

Figure 1: Holotype; Figure 2: Hypotype No. 1; Figure 3: Paratype No. 3; Figure 4: Paratype No. 4; Figure 5: Paratype No. 5; Figure 6: Paratype No. 6; Figure 7: Paratype No. 7; Figure 8: Paratype No. 1; Figure 9: Paratype No. 2. Hypotype No. 1 collected just north of Carnarvon, all others at Vlaming Head; Paratypes 1 and 2 are subfossil specimens. Photos by Takeo Susuki. (x 2)